

SN 11/723,075
Docket No. S-102,315
In Response to Office Action dated June 27, 2007

REMARKS

Claim Status

Claims 1-4 are pending in the present application.

Rejections

1. Rejection Under 35 USC §103(a) Over U.S. Patent 4,277,323 ("Muller"), in view of U.S. Patent 5,028,404 ("Carberry").

The Office Action rejects claims 1-3 under 35 U.S.C. 103(a) over Muller in view of Carberry, asserting that although Muller does not explicitly disclose the electrode to be a metal oxide, that Carberry teaches metal oxides as viable alternative to noble metal catalysts including platinum in combustion chamber exhaust gases, and that it would have been obvious to one of ordinary skill in the art to have substituted the metal electrode of Muller with the metal oxide of Carberry. Applicants respectfully traverse.

According to *In re Vaeck*, 20 USPQ2d 1438, to establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.

The present invention is directed toward a hydrocarbon sensor. The Office Action admits that Muller teaches metal oxide as a viable alternative to noble metal *catalysts*. In other words, Carberry teaches how to convert one chemical species to another in exhaust gases. The present invention comprises both a sensor and a reference electrode and detects *differences* in the electrochemical reaction rates occurring on these electrodes at the electrode/electrolyte/gas phase interface. As one of skill in the art would understand, an electrode with a high catalysis rate would not be desirable because the sensed gas concentration would be diminished by catalysis as the gas diffuses towards the electrochemical triple phase interface. Thus, to obtain accurate measurements with a sensor, catalysis should be avoided. Furthermore, Carberry teaches that the metal oxide electrode is a suitable substitute for a platinum electrode, and thus behaves similarly. As

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stated above, Applicants' invention relies on differences in electrochemical reaction rates occurring between the metal oxide and the reference electrode. For these reasons, Carberry teaches away from using metal oxides as sensors, and one of skill in the art would not be motivated to adopt the teachings of Carberry.

Furthermore, assuming for the sake of argument only that the metal oxide of Carberry were substituted for the metal electrode of Muller, this would not result in Applicants claimed invention. Muller teaches an oxygen sensor. The sensor is applied to one surface of an insulated carrier plate or substrate. See Muller, Col. 1, lines 65-68. The carrier plate is an essential element of Muller's invention, is pervious to oxygen molecules (porous), and the oxygen molecules pass through the substrate to reach the electrodes. See Muller, Col. 2, lines 3-7. Whereas such a construct may work for oxygen molecules, which are relatively stable, this would not allow detection of hydrocarbons. As is explained on page 2, line 24 through page 3, line 3 of the Applicants' specification, when a hydrocarbon is forced to meander through pores of a material, it may be catalyzed in the presence of oxygen to non-hydrocarbon products. This reduces sensitivity. The present invention solves this problem by ensuring that the hydrocarbon is in direct contact with the three-phase interface, thus eliminating the need for the hydrocarbon to diffuse through a porous material to the 3-phase interface for detection (see specification, page 2 lines 15 - 17). In addition, Applicants point out that the present invention further relies not just upon the proper selection of the oxide electrode, but also upon the precise control of the surface area of the electrode and the 3-phase interface region of the sensor. See specification, page 4, line 30 through page 5, line 3. None of these aspects are taught by Muller or by Carberry.

For the above reasons, Applicants assert that it would not have been at all obvious for one of skill in the art to combine the teachings of Muller and of Carberry, and the combination of Muller and Carberry fail to satisfy any of the requisite elements for establishing a prima facie case of obviousness. Applicants respectfully request that this rejection be withdrawn.

2. Rejection Under 35 USC §103(a) Over U.S. Patent 4,277,323 ("Muller") in view of U.S. Patent 5,028,404 ("Carberry") in further view of U.S. Patent 4,755,274 ("Mase").

The Office Action rejects claims 4 under 35 U.S.C. 103(a) over Muller in view of Carberry as applied to claim 1, in further view of Mase. The Office Action asserts that it would have been obvious to stabilize the zirconia electrolyte body of Muller with yttria as

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taught by Mase and to produce a desired porosity of the electrolyte body by sintering as taught by Mase. Applicants respectfully traverse.

First, for the reasons stated above, there would have been no motivation for one of skill in the art to combine Muller with Carberry to arrive at the invention of claim 1. Because claim 4 depends from claim 1 and incorporates all elements thereof, it would be similarly non-obvious to combine Mase with Muller and Carberry. Also for the reasons stated above with respect to Muller and Carberry, the further combination of Mase would fail to produce Applicants' claimed invention.

Second, Applicants claim 4 is directed toward a desired *density* rather than porosity, as stated by the Office Action. As described above, a porous electrolyte body would not result in a suitable hydrocarbon sensor. Thus, Applicants' invention utilizes a dense rather than a porous material. Mase teaches the use of a porous ceramic layer (see *inter alia* Mase, Col. 2, lines 40 – 43) and fails to teach an electrode body contained within the electrolyte body and having a first electrode surface coplanar with the first electrolyte surface.

For the above reasons, Applicants assert that it would not have been at all obvious for one of skill in the art to combine the teachings of Muller, Carberry, and Mase, and the combination of references fails to satisfy any of the requisite elements for establishing a *prima facie* case of obviousness. Applicants respectfully request that this rejection be withdrawn.

3. Rejection Under 35 USC §103(a) Over U.S. Patent over U.S. Patent 5,543,025 ("Garzon") in view of U.S. Patent 5,028,404 ("Carberry").

The Office Action rejects claims 1-4 under 35 U.S.C. 103(a) over Garzon in view of Carberry. The Office Action admits that Garzon fails to disclose a metal oxide electrode, but that Carberry teaches a metal oxide as a viable alternative to noble metal catalysts. Applicants respectfully traverse, and reiterate the arguments presented above with respect to Carberry.

Applicants further point out that Garzon fails to teach an electrode body contained within the electrolyte body and having a first electrode surface coplanar with the first electrolyte surface, in contrast to the Office Action's assertion. Rather, Figure 2 of Garzon depicts a mixed conductor 34 that is non-coplanar with the electrolyte 32. Furthermore, the electrolyte is deposited onto the conductor layer rather than the

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electrode body being contained within the electrolyte body. See Garzon, col. 3, lines 26-37.

Figure 2 further depicts an oxygen sensor in which the oxygen must pass through a porous substrate (col. 3, lines 32-33). As Applicants described above, whereas having a sample pass through a porous substrate may be suitable for an oxygen detector, such a device would not be useful for detecting hydrocarbons. Thus, one of skill in the art would have no motivation to look to the teachings of Garzon to produce a hydrocarbon sensor.

For the above reasons, Applicants assert that it would not have been at all obvious for one of skill in the art to combine the teachings of Garzon and Carberry, and the combination of references fails to satisfy any of the requisite elements for establishing a *prima facie* case of obviousness. Applicants respectfully request that this rejection be withdrawn.

4. Rejection Under 35 USC §103(a) Over U.S. Patent over U.S. Patent 5,543,025 ("Garzon") in view of U.S. Patent 5,028,404 ("Carberry") in further view of U.S. Patent 4,755,274 ("Mase").

The Office Action rejects claim 4 under 35 U.S.C. 103(a) over Garzon in view of Carberry in further view of Mase, asserting that it would have been obvious to produce a desired porosity of the electrolyte body by sintering as taught by Mase. Applicants respectfully traverse.

First, for the reasons stated above, there would have been no motivation for one of skill in the art to combine Garzon with Carberry to arrive at the invention of claim 1. Because claim 4 depends from claim 1 and incorporates all elements thereof, it would be similarly non-obvious to combine Mase with Garzon and Carberry. Also for the reasons stated above with respect to Garzon and Carberry, the further combination of Mase would fail to produce Applicants' claimed invention.

Second, Applicants claim 4 is directed toward a desired *density* rather than porosity, as stated by the Office Action. As described above, a porous electrolyte body would not result in a suitable hydrocarbon sensor. Mase teaches the use of a porous ceramic layer (see *inter alia* Mase, Col. 2, lines 40 – 43) and fails to teach an electrode body contained within the electrolyte body and having a first electrode surface coplanar with the first electrolyte surface.

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For the above reasons, Applicants assert that it would not have been at all obvious for one of skill in the art to combine the teachings of Garzon, Carberry, and Mase, and the combination of references fails to satisfy any of the requisite elements for establishing a prima facie case of obviousness. Applicants respectfully request that this rejection be withdrawn.

Conclusion

This response represents an earnest effort to address the multiplicity of rejections under 35 U.S.C. 103(a), to place the application in condition for allowance and to distinguish the invention as now claimed from the applied references. In view of the foregoing, reconsideration of this application and allowance of Claims 1-4 is respectfully requested.

Respectfully submitted,

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